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COMPARSION BETWEEN SOME PROPERTIES OF NANO AND MICRO PVC FIBERS REINFORCED POLYESTER COMPOSITES

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ABSTRACT

This search aim to studying of some properties involve (density, Shore D Hardness, Impact strength, and Bending strength) of two types of polyester composite. The first type is polyester as a matrix phase and Micro PVC fibers with (2-4 µm diameter) as a reinforcement phase, while the second types is a polyester as a matrix phase also and Nano PVC fibers with (100 nm) as a reinforcement phase the comparison between above properties was presented.

100 nm PVC fibers by electrospinning technique were prepared, also Micro PVC with (2-4 µm).(25%-75%) volume fraction of nano and micro PVC fibers for reinforced unsaturated polyester were .used. Results refer to more advancement of all properties of nanocomposites (NPVC.UPS) than micro composites (MPVC.UPS), as well as there are an rising of these properties with increasing the volume fraction of fibers was noticed.

KEYWORDS: Nanocomposites, PVC Nanofibers, PVC Microfibers, Mechanical Properties

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INTRODUCTION

Micro polymer - fibers composite is a polyphase solid material consist of two component, the first is a polymer matrix and micro fibers as a reinforcement materials [1]. When material shifting from large volumes to nano-meter size, all properties in addition that, it gain an unique properties, not exist in the physical origin [2]. There are many advantages of polymer-nano fibers composites such as volume ratio is bigger than in traditional composites. As a result, the volume fraction of the second phase can be reduced, without deterioration it's properties[3]

Nanofibers have many best properties such as wide surface area, high porosity, small pore size, and thin diameters [4]. The best method for producing the nanofibers is electros pinning technique. Electro spinning technique is the ideal way for the production of polymeric fibers with various diameters ranging (some nano-many microns). Electro spinning technique consist of three main elements:

- High voltage power supply 5 kV to more than 50 kV
- Metallic ground collector
- Syringe pump with medical syringe for pump the polymer solution.

Figure (1) show the typical set up of electrospinning technique. Electrospinningnano fibers used in many application such as filters, medical fields engineering, surfacemodifications, and sound absorptive materials, and

nanocomposite[5]. NanocompositeAirframes and motor sports supplies were used.[6-7]

MATERIALS AND METHODS

In this search the following materials were used:

- Micro PVC fibers with (2-4 µm) diameter.
- Nano PVC fibers with (100 nm) diameter.

These fibers by electrospinning technique were prepared by balancing of (1.1g) and (1.5 g) of powder PVC polymer with Mw = 86,000 and 1.5 g/mL density at 25 °C, from Iranian Company, and dissolved in (10 ml) of Tetra hydro furan (THF) with Boiling point (68oC) China for 6hr. tohomogenous solution with (0.11) and (0.15) g/ml concentration respectivelyand used as reinforcement phase. Table (1) show the conditions of fibers preparation and Figure (2 a-b) show the microfibers and nanofibers images. 3- Unsaturated poly ester with 1gm/cm3 density as a matrix phase was used. Hand molding process for preparation of samples of (density, Shore D Hardness, Impact Strength, and Bending Strength) properties according to ISO and ASTM for mechanical properties of polymers was used. Samples prepared by taking (0,25%,50%,&75%) weight ratio of both types of nano and microPVC fibers, then they mixed with (polyester resin +hardener) and leave it for 24 hr for completely harden. table (2) show the samples which used at this search.

RESULTS AND DISSCISIONS

Density

Density Results refers to increase of microcomposite density with increasing of the weight ratio of microfibers, and it reduced with increasing of the weight ratio of PVC nanofibers in nanocomposite, density slipfrom (0.95) gm/ cm3 of pure polyester to (0.45) gm/cm3 of (UPS + 75%) nanofibers as in figure (3). This is because the nanofibers have lower density than pure UPS. Also the nanofibers is merged significantly with matrix material [8], also this result Agrees with therule of mixer in the composites.

Hardness

Shore D Hardness results show there are an increasing of hardness with increasing of the weight ratio of PVC nanofibers in nanocomposite and microcomposite, it increases from (50) of pure UPS to (70) of UPS with (75%) MPVCF, while it increases to (70) in nanocomposites with the same ratio of NPVCF as in figure (4). This is the high aspect ratio, high modulus, intensity of PVC fibers contributed to the strengthen by improving hardness value.[9] In addition that, there are lower increasing micro composites hardness than nanocomposite.

Bending Test

Bending strength (B.S) of nano and micro composites increase with increasing of the volume fraction of PVC fibers were noticed. (B.S) raises from (2 MPa) of pure UPS to (6 MPa) of UPS with (75%) MPVC fibers, while it raise to (10 MPa) in nanocomposites with the same ratio of NPVCF as in figure (5). This is the because there are an increasing of suppleness after adding of fibers was occurred in addition that the ratio of increasing of bending strength in micro composite less than nanocomposite, this is because high elasticity of nanocomposites.[10]

Impact Strength

Impact test results show the addition of the NPVCF and MPVCF is able to increase of impact strength of the pure

substrate and it increases with increasing of weight ratio of two types of fibersas in Figure (6). This is because the micro and nano PVC fibers leads to raise ductility of nanocomposite, it leads to increasing of absorbing energy of impact test. The impact energy raises to (0.65) k.j with (75%) of MPVC fibers in micro composites, while it up to (0.72 k.j) with (75%) wt.% of NPVC fibers in nanocomposites.[11]

CONCLUSIONS

Concluded that all the properties of overlapping models getting better after using fiber as a strengthening of nanoparticles.

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APPENDICES

Table 1: Show the Preparation Factors of Nano and Micro PVC Fibers by Electrospinning Technique

PVC Fibers Type	Con. of Solution	Voltage kV	Other Parameters
Micro fibers (about 2 – 4 µm	15 % (PVC+THF)	15	Electrospinning distance =15 cm Capillary tip = 0.48 mm Flow rate = 0.5 ml/hr
Nano fibers (about100 nm)	11% (PVC+THF)	25	

Table 2: Show the all Tests in this Search

Sample No.	Test	Dimensions
1	Bending strength	50*10*4.4 mm
2	Impact strength	55mm
3	Shore D Hardness	2*2 cm2
4	Density	3*3 cm2

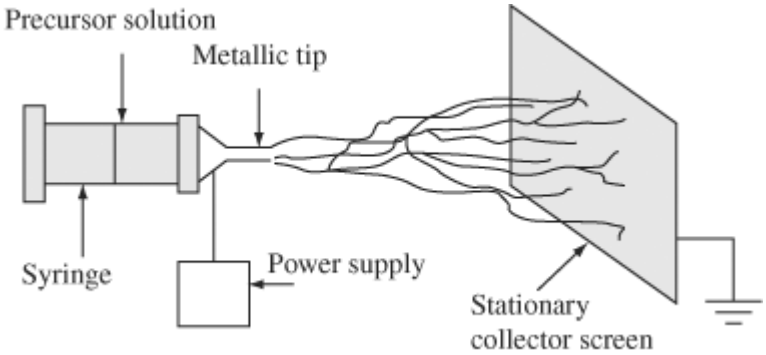
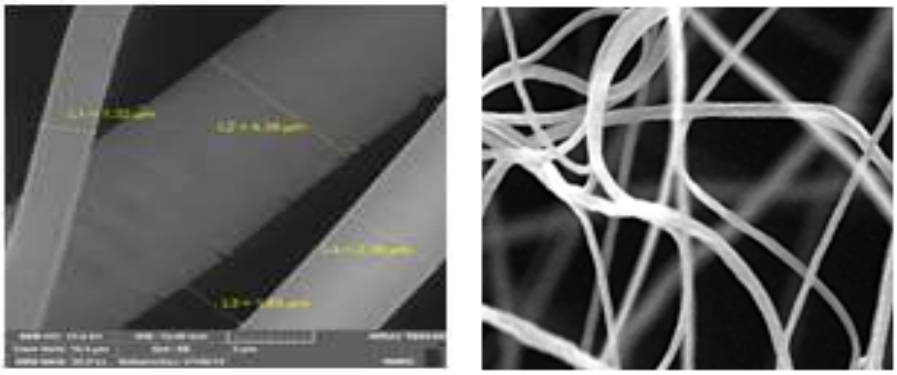


Figure 1: Electrospinning Set Up



(a) Micro PVC Fibers **(b) Nano PVC Fibers**

Figure 2: Shows (a) Micro PVC Fibers (b) Nano PVC Fibers

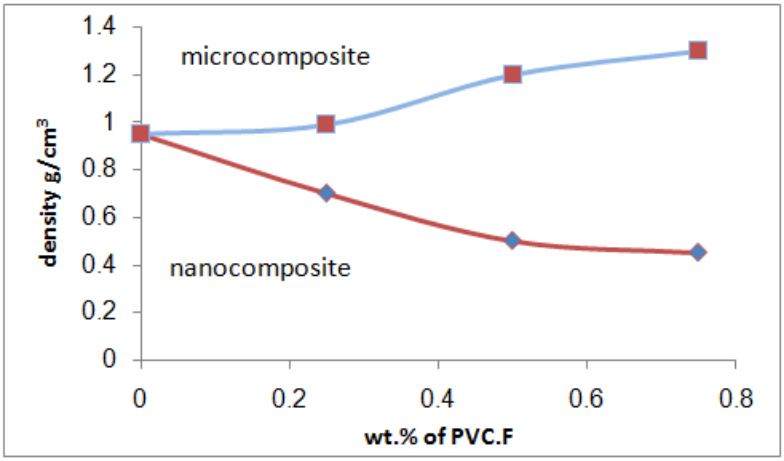


Figure 3: Show the Relationship between the Weight Ratio of PVCF and Density of Two Types of Composite

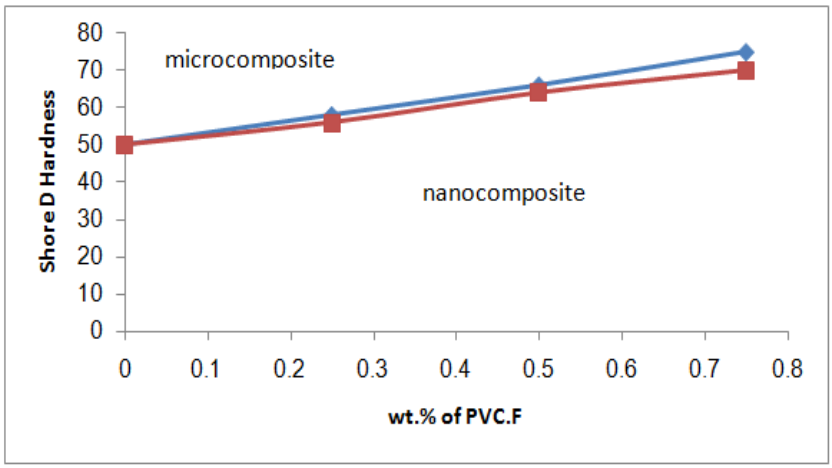


Figure 4: Show the Relationship between the Weight Ratio of PVCF and Shore D Hardness of Two Types of Composites

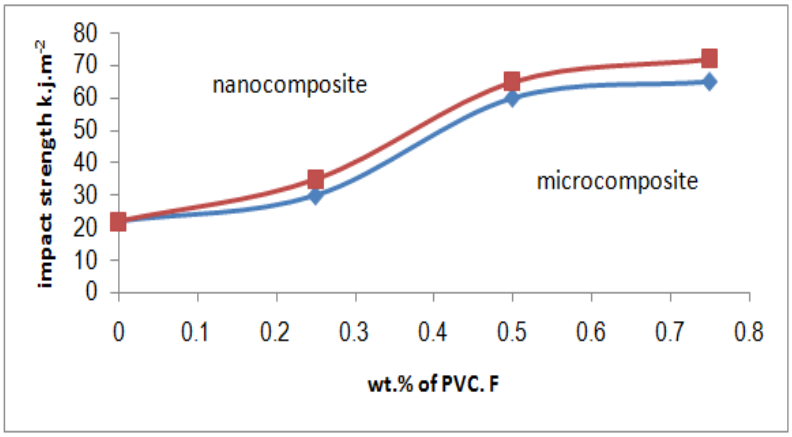


Figure 5: Show the Relationship between the Weight Ratio of PVCF and Impact Strength of Two Types of Composites

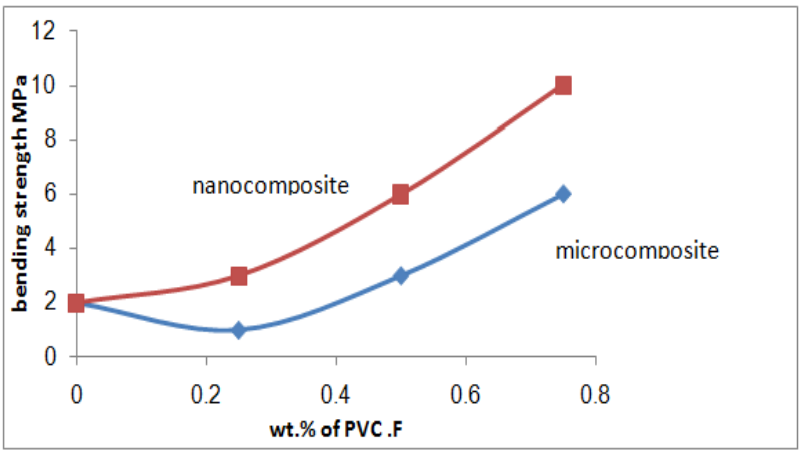


Figure 6: Show the Relationship between the Weight Ratio of PVCF and Bending Strength of Two Types of Composites